DartPower User Manual and Quick Start Guide Version 2.0

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DartPower 2.0 User Manual

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Parts List

Congratulations on your purchase of AccuPower. AccuPower sets a new standard of excellence for portable force platform technology and functional assessments of dynamic human movement.

The following parts should be included in your shipment:

- 30" x 40 " AccuPower force platform
- 110-240V switching power supply
- 15' cable terminating in RJ14 and DB9 connectors. DB9 end also has a "pigtail" for the power supply connection.
- USB to RS232 converter
- CD containing the AccuPower Software and manual
  - Also contains calibration values for force platform from AMTI. **Please note that the Digital_xxx.acl file must be used with AccuPower. The analog_xxx.acl file is for integration with the analog output interface.**

Minimum Hardware Configuration for Windows PC

DartPower **Operating System**: Windows 2000 Professional (updated to SP4) or
Windows XP Professional (updated to SP2)
Processor speed: Intel PIII or Celeron operating at 800 MHz or greater, Athlon 800 MHz or greater.
RAM: 128 Mb or greater
Graphics: 32 Mb graphics card; 1028x768 w/ 16-bit resolution
Hard-drive Space: 20 Mb. 500 Mb is recommended for storing data associated with longer test durations (up to 500 Kb/file).

Quick Start Guide for AccuPower

Hardware Connections and Setup

- Connect your PC to the AccuPower plate using the grey cable provided.
- The RJ-14 (phone jack type) connector plugs into the female connector on the AccuPower plate. The jack is located near the

handle of the platform.

• The DB9 (9-pin serial connector) end of the cable should go to either the serial port or USB to serial adapter.

• When you first plug in the USB to serial adapter, follow the instructions of the Windows hardware wizard to properly install the device. Depending on your OS version, you may have to insert the hardware CD included with the device

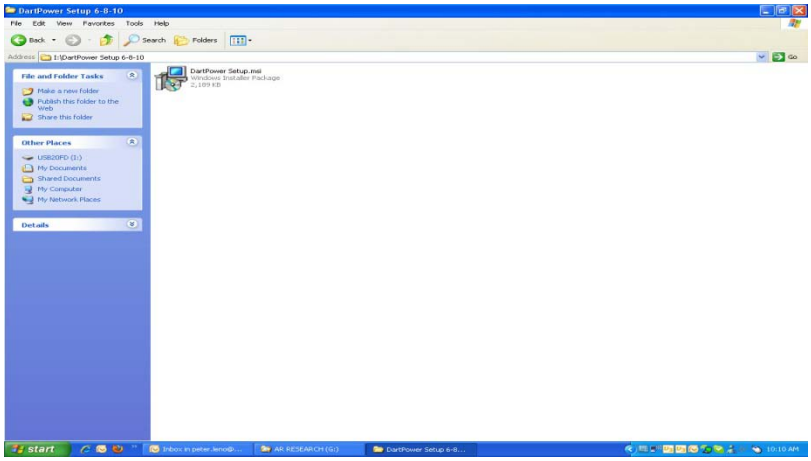
- Note: Use the USB to serial adapter if you require sample rates above 200 Hz or if the PC does not have a serial port.

• Connect the universal power supply to AC (110-240V) power and to the “pigtail connector” on the cable.

- *It is recommended that the platform be plugged in for at least 30 minutes prior to testing to ensure optimum performance.

Software Installation and Configuration

• Insert the DartPowerInstallation CD



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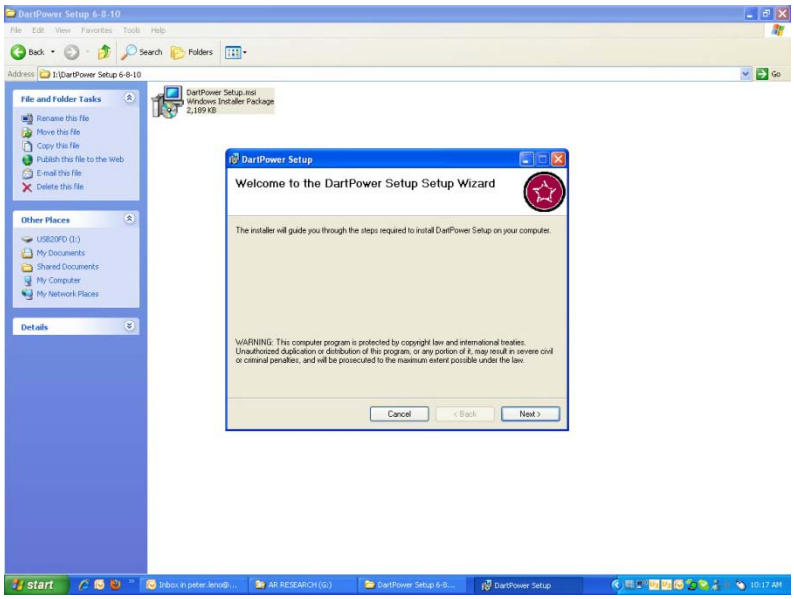
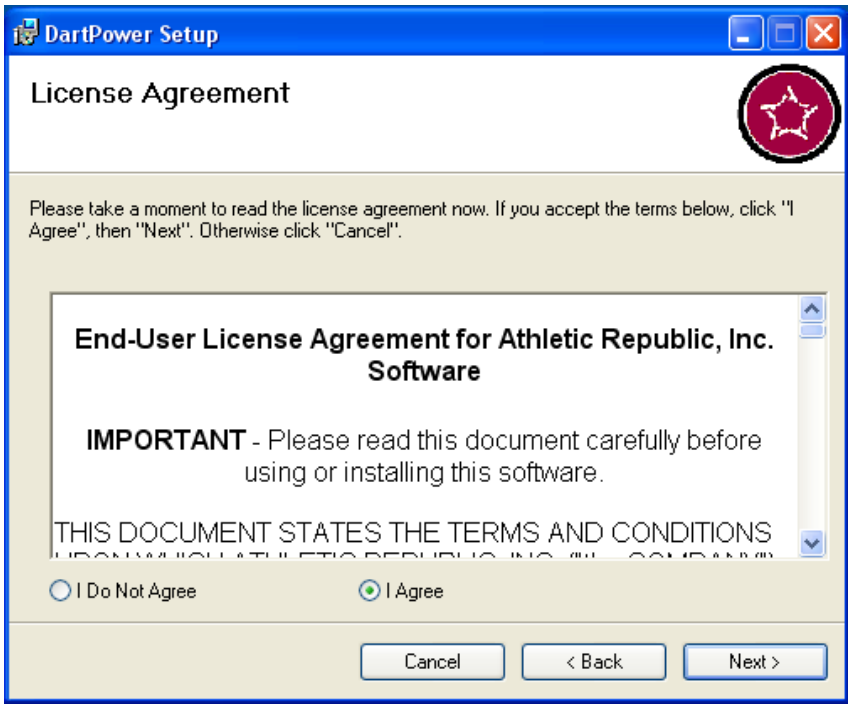
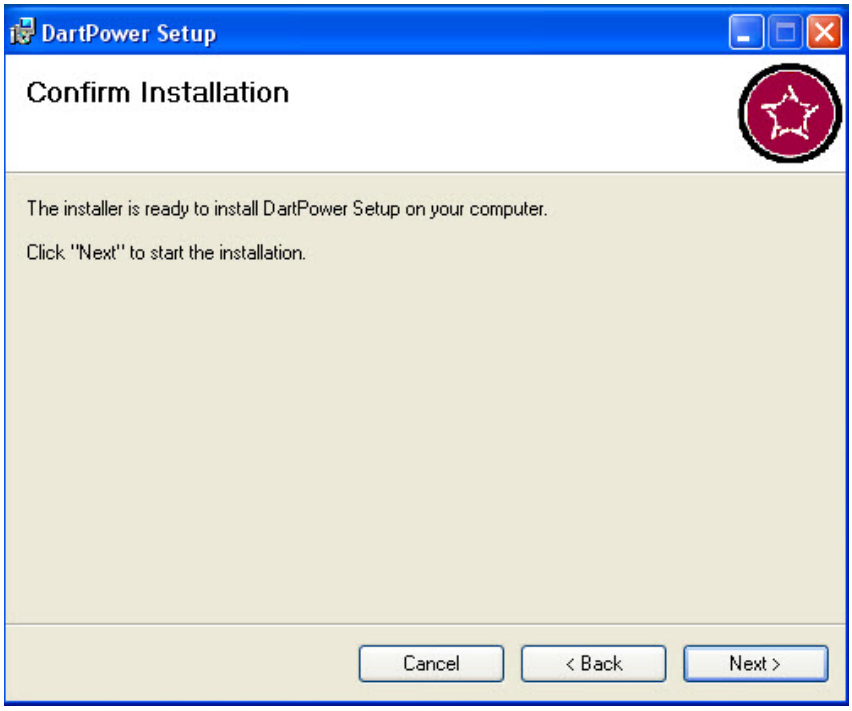
• Select **“”** and follow instructions from Wizard.


DartPower Setup 6-8-10
DartPower Setup
Welcome to the DartPower Setup Setup Wizard
The installer will guide you through the steps required to install DartPower Setup on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
< Back
Next >

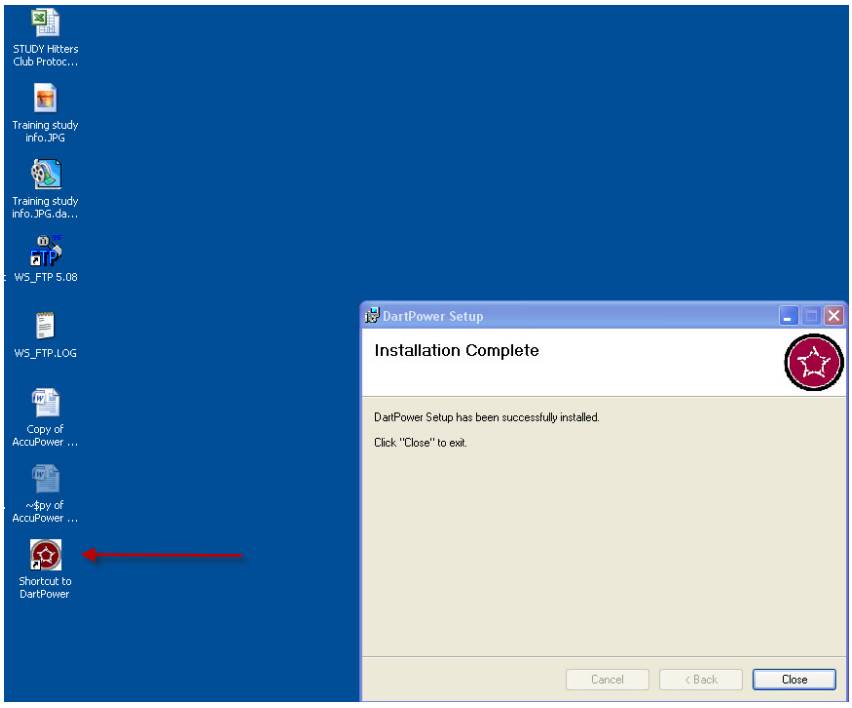
Left Click Next


DartPower Setup
License Agreement
Please take a moment to read the license agreement now. If you accept the terms below, click "I Agree", then "Next". Otherwise click "Cancel".
End-User License Agreement for Athletic Republic, Inc. Software
IMPORTANT - Please read this document carefully before using or installing this software.
THIS DOCUMENT STATES THE TERMS AND CONDITIONS
I Do Not Agree
I Agree
Cancel
< Back
Next >

Select “I Agree” at License Agreement


DartPower Setup
Confirm Installation
The installer is ready to install DartPower Setup on your computer.
Click "Next" to start the installation.
Cancel
< Back
Next >

Left Click “Next” to begin installation



When installation is complete, an icon will appear on your desktop. click close.

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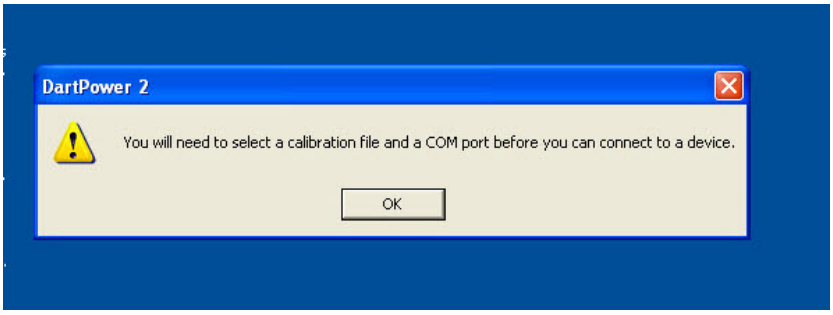
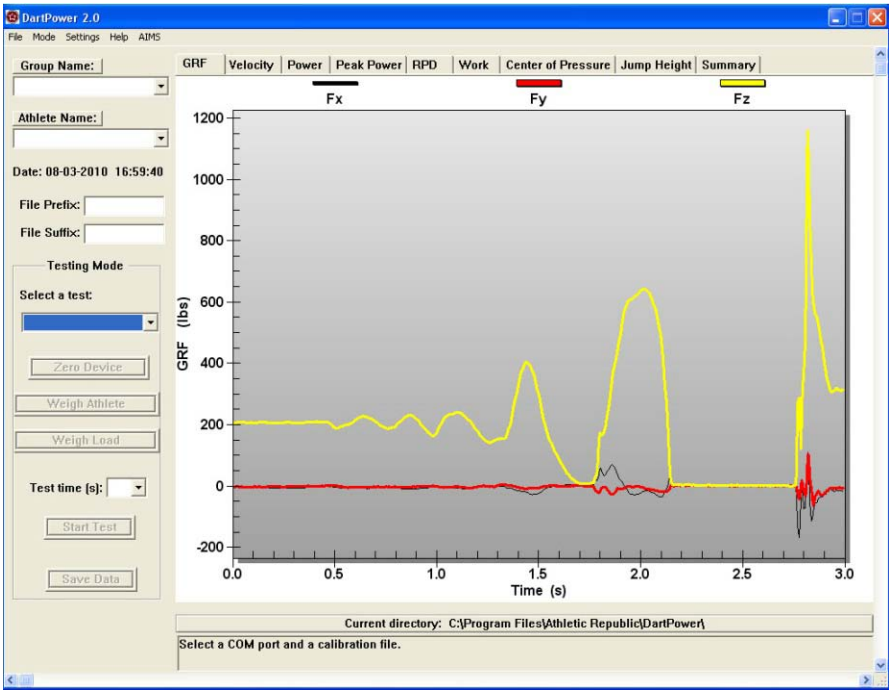
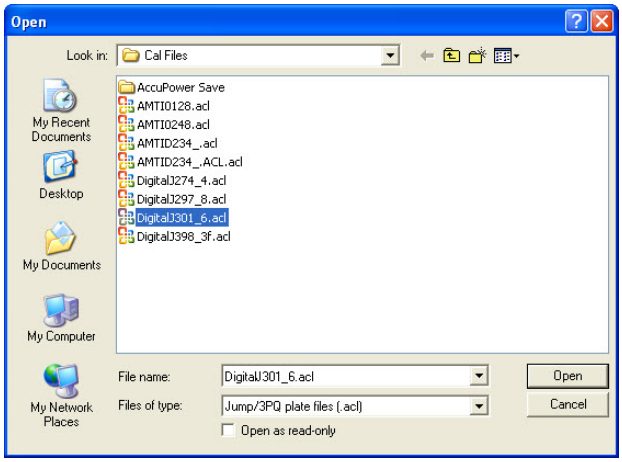
• Launch DartPowerfrom the **Icon on the desktop**



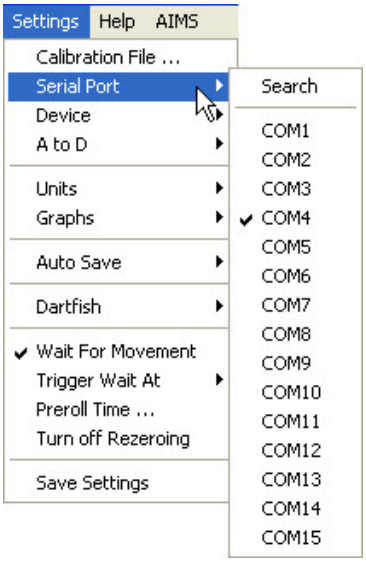
Click OK to enter the application.



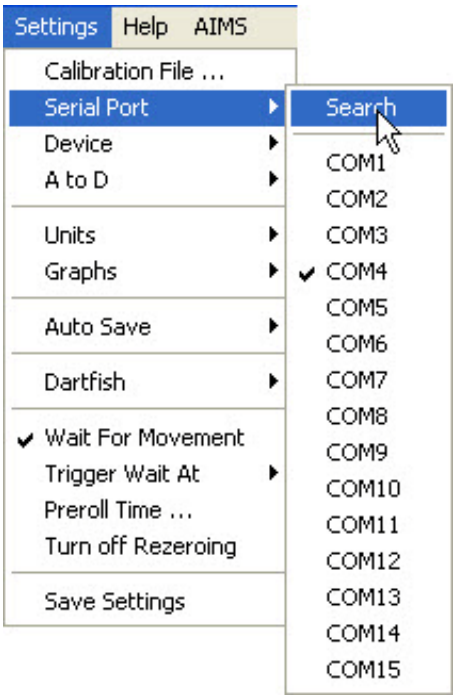
• Go to **Settings** Menu to select proper calibration file for the device.

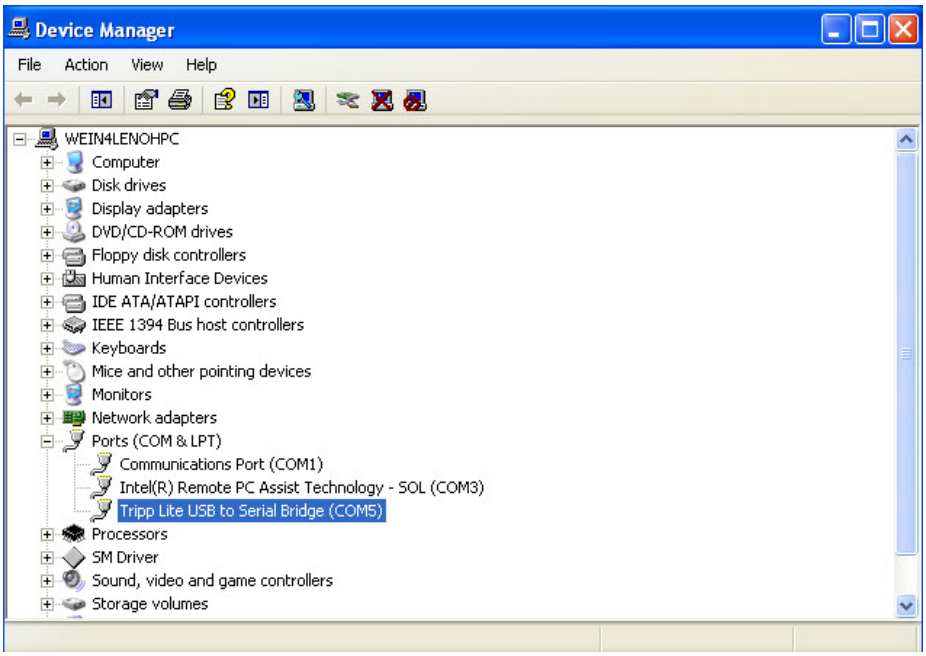


• Go to **Settings** Menu to select serial port that the device is connected to.



You can do so by choosing the “Search” option or by identifying the proper port in the Device Manager.





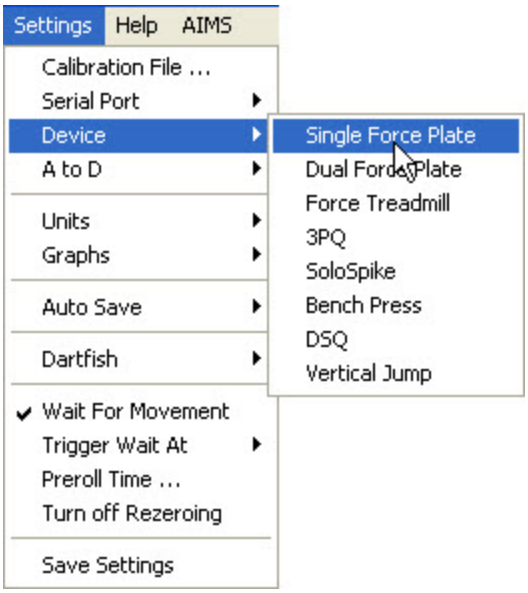
• Select **Settings/Save Settings** to store the selected settings as DartPower defaults.

Conducting a Test

Single Vertical Jump Test

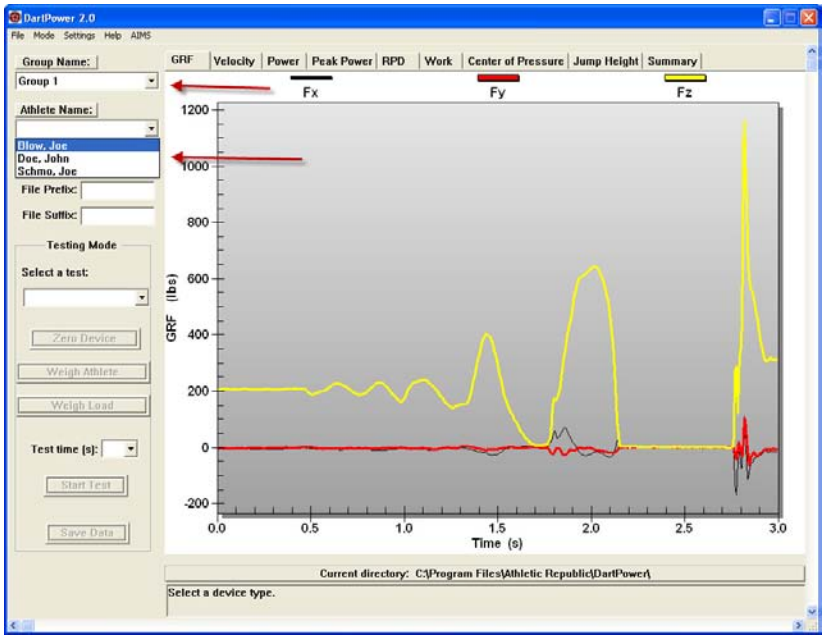
- Ensure the platform and power supply cables are connected to the PC.
- Launch DartPower software from desktop icon.
  - Check to be certain you have the proper Calibration file and Serial Port selected.

  Go to **Settings** Menu to select device. Choose “Single Force Plate”. Once the device is selected, communication is established with the force plate.

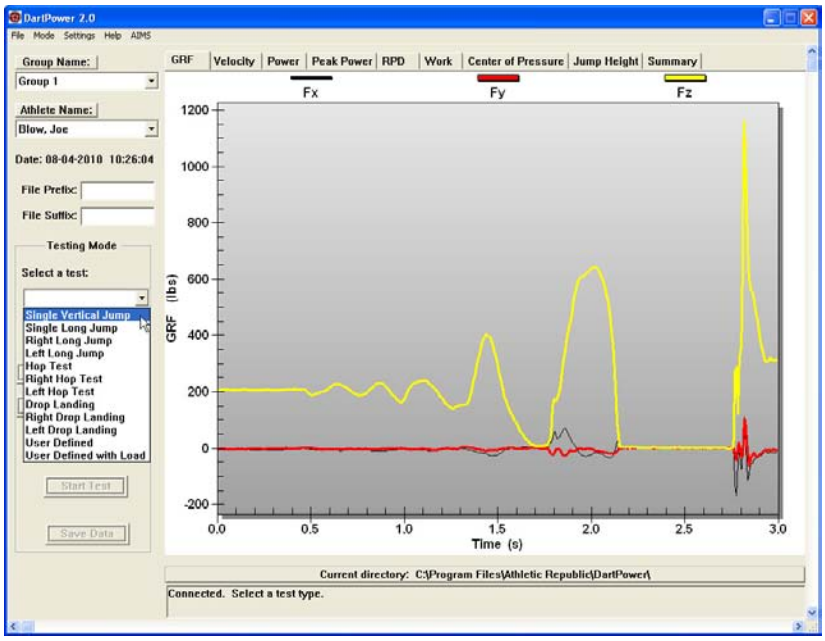


• Save Settings.

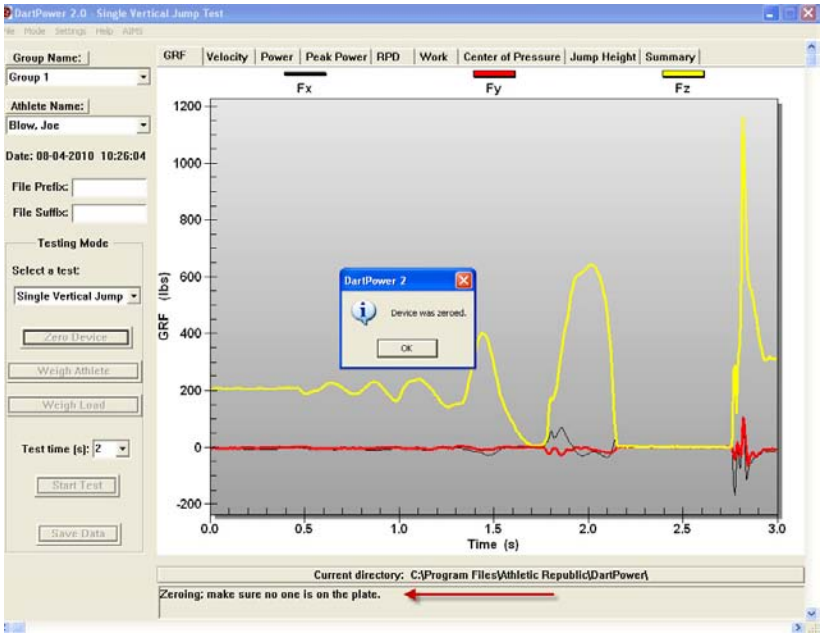
• Select proper athlete(s) for testing. This can be accomplished thru the use of an RFID bracelet linked to the athlete(s) or by manually selecting the proper athlete from the drop down menu(s) on the left side. Groups and athletes are downloaded from AIMS at login.



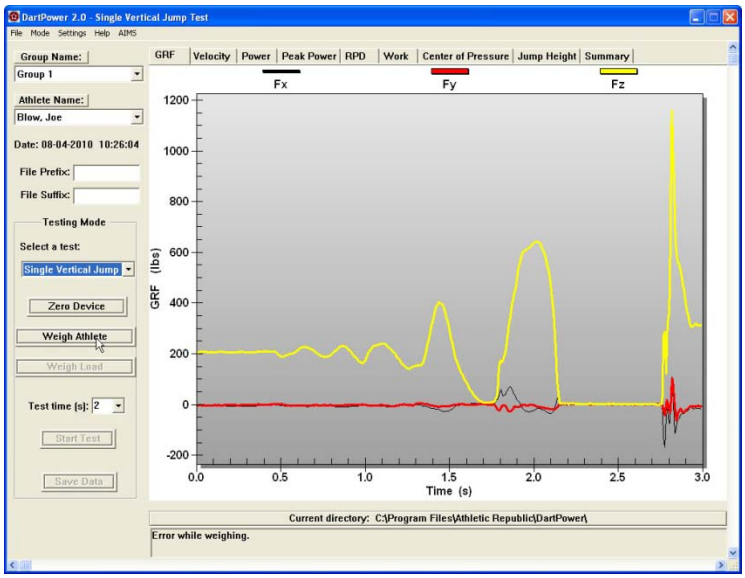
• Select a test type using the drop-down menu on the left side of the screen..



• Click “Zero Device” to zero the platform. A message will be displayed on the screen when completed. Make sure the platform is unloaded!



•Next weigh the subject. Have the selected athlete stand on the middle of the plate to be weighed. Each athlete needs to be weighed only once each evaluation session. Click “Weigh Subject”
. Beeps will indicate the beginning and end of
the weighing process.



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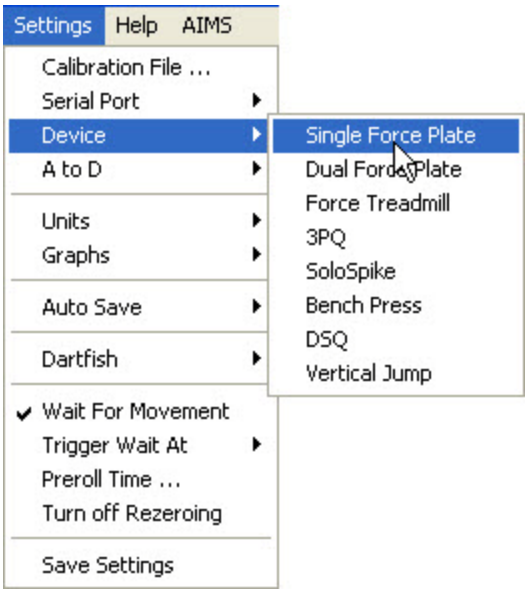
• Click “Start test” to begin collecting data.
o For any power analysis, it is important that data collection be started BEFORE the subject starts to move to ensure accurate power calculations to be done. In other words, the subject should not be moving when the test is started.
o A progress bar window will appear and indicate when the test progress through completion.

Single Long Jump Test

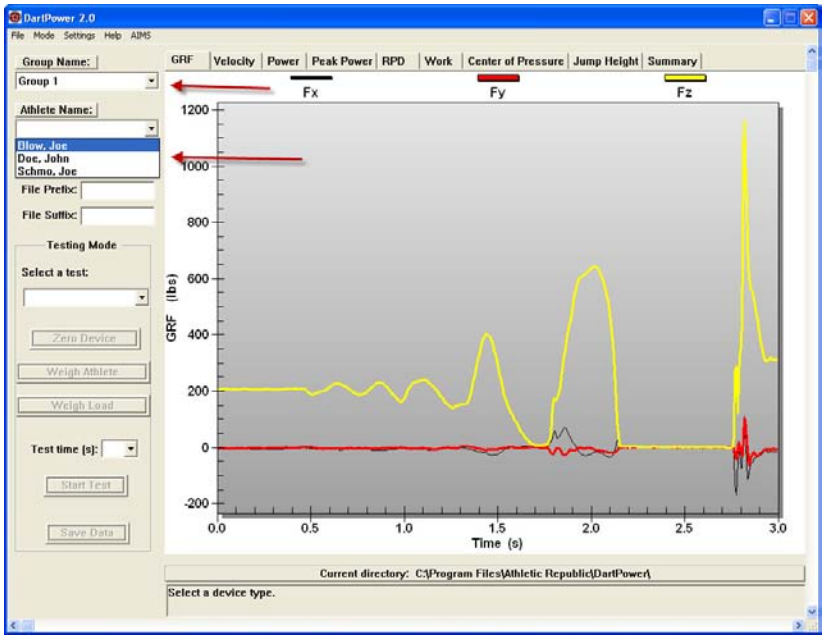
• Ensure the platform and power supply cables are connected to the PC.
• Launch DartPower software from desktop icon.
  • Check to be certain you have the proper Calibration file and Serial Port selected.

- Go to **Settings** Menu to select device. Choose “Single Force Plate”. Once the device is selected, communication is established with the force plate.

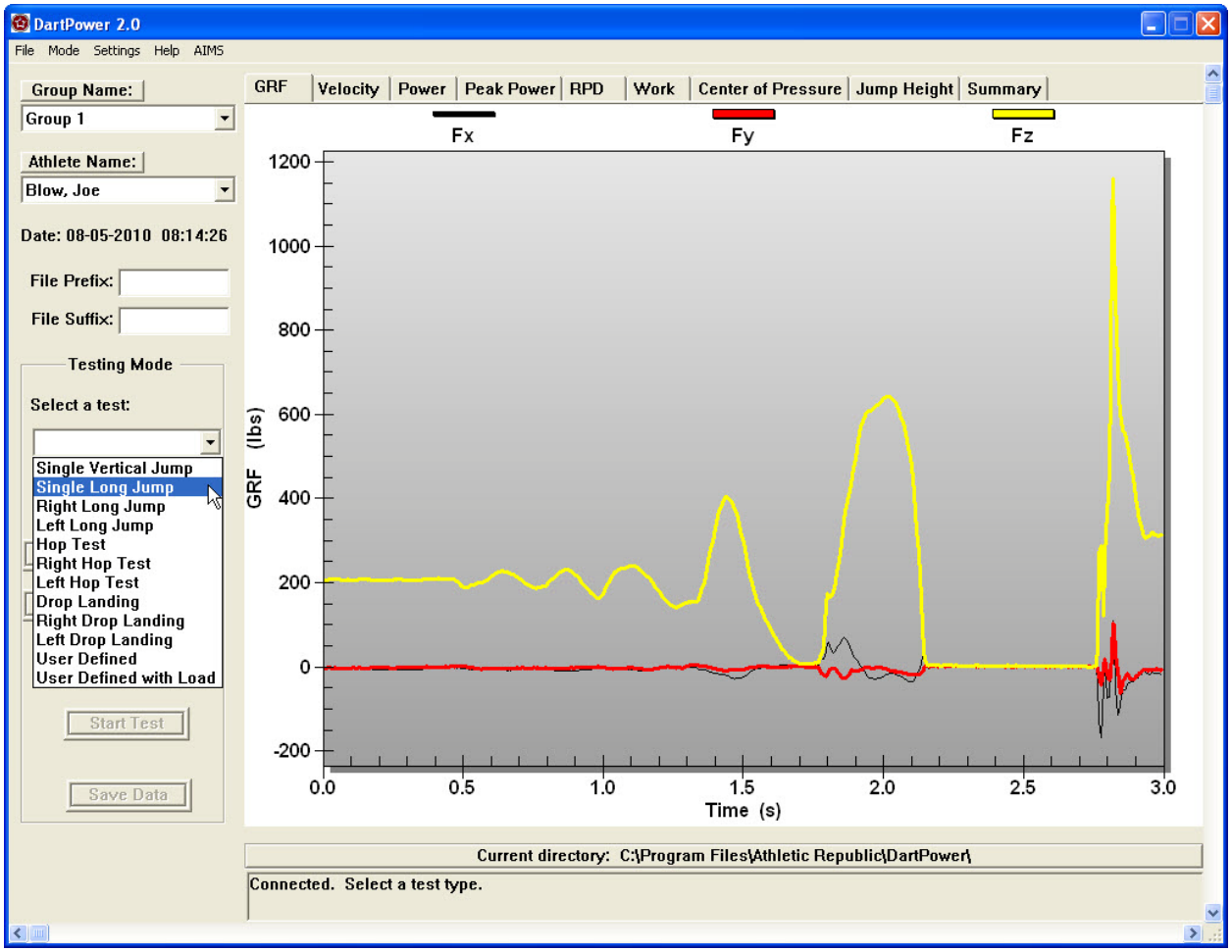


• Save Settings.

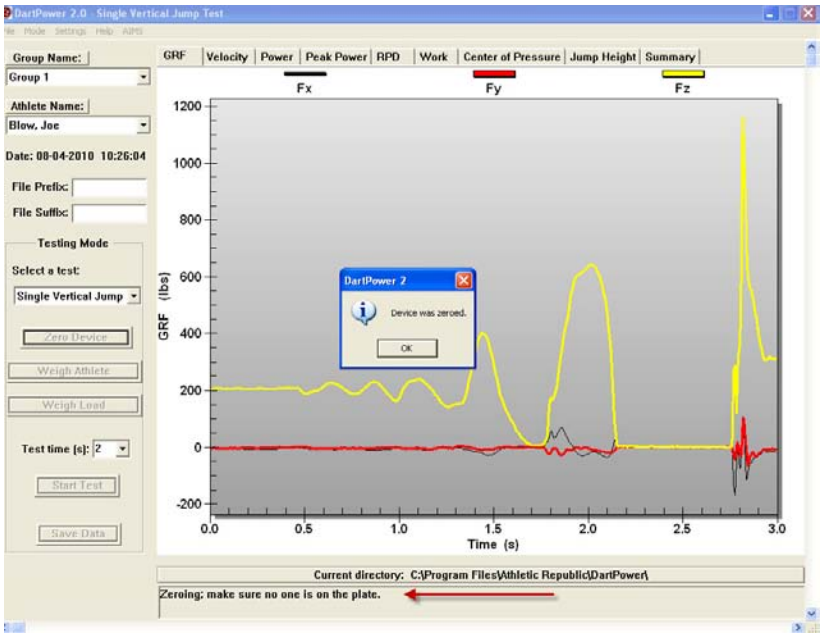
• Select proper athlete(s) for testing. This can be accomplished thru the use of an RFID bracelet linked to the athlete(s) or by manually selecting the proper athlete from the drop down menu(s) on the left side. Groups and athletes are downloaded from AIMS at login.



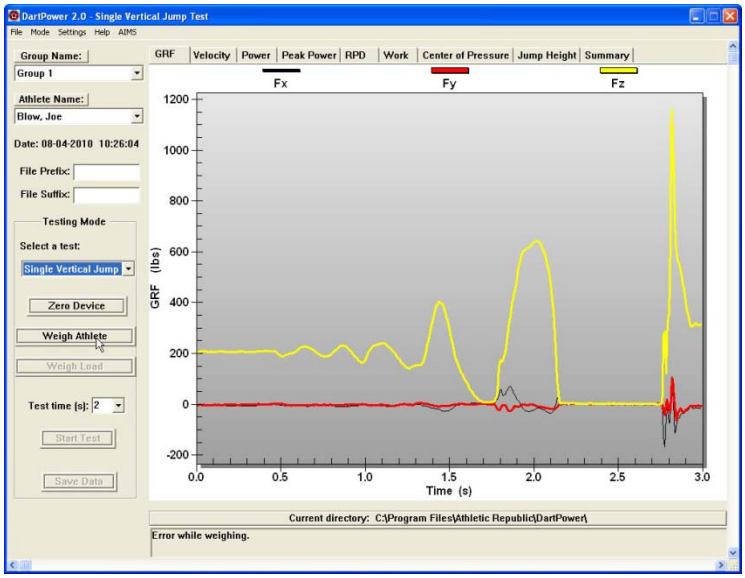
• Select a test type using the drop-down menu on the left side of the screen..



• Click “Zero Device” to zero the platform. A message will be displayed on the screen when completed. Make sure the platform is unloaded!



•Next weigh the subject. Have the selected athlete stand on the middle of the plate to be weighed. Each athlete needs to be weighed only once each evaluation session. Click “Weigh Subject.



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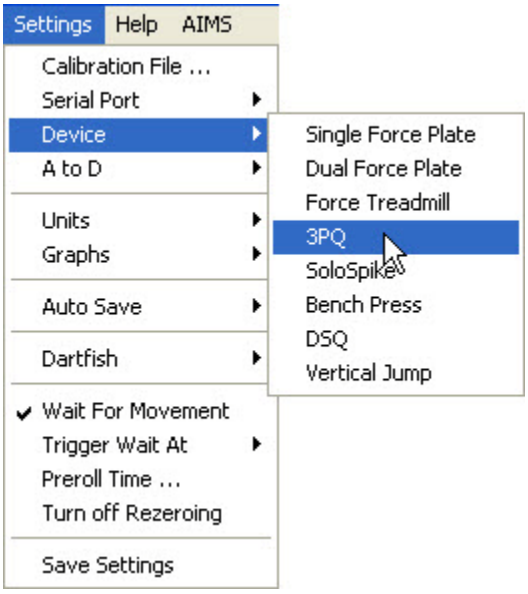
• Click “Start test” to begin collecting data. For any power analysis, it is important that data collection be started BEFORE the subject starts to move to ensure accurate power calculations to be done. In other words, the subject should not be moving when the test is started.

o A progress bar window will appear and indicate when the test progress through completion.

3PQ Jump Test

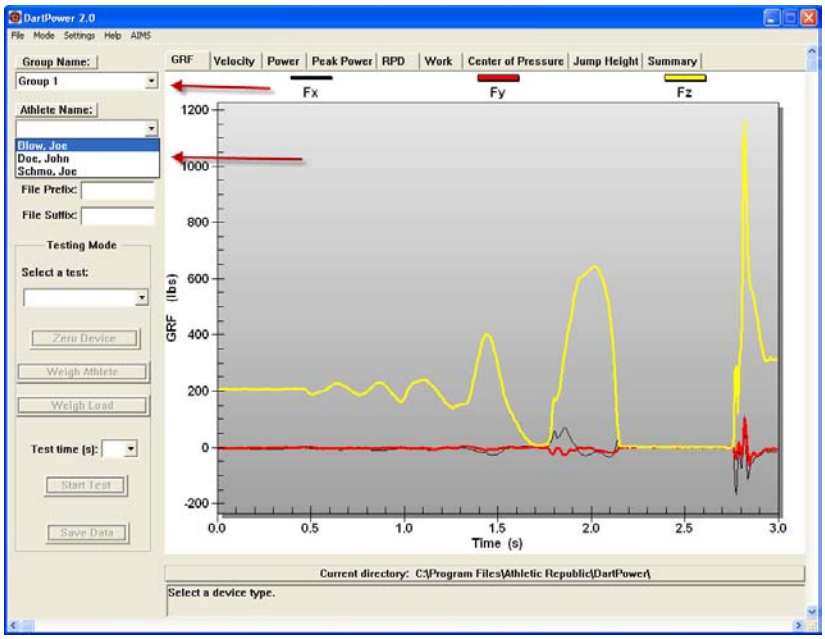
• Ensure the platform and power supply cables are connected to the PC. Also, ensure the Displacement Transducer is properly attached to the Plyo Press.
• Launch DartPower software from desktop icon.
  • Check to be certain you have the proper Calibration file and Serial Port selected.

  Go to **Settings** Menu to select device. Choose “3PQ”. Once the device is selected, communication is established with the force plate.

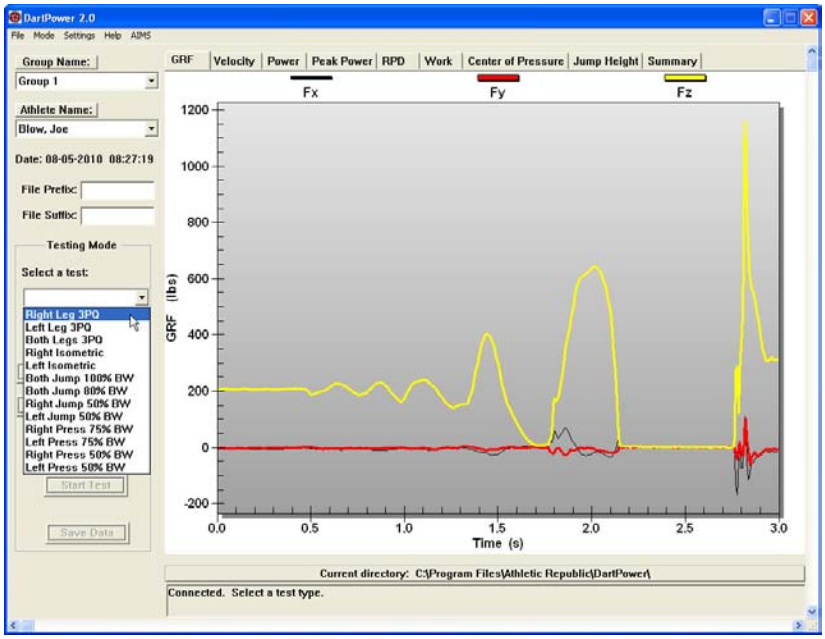


• Save Settings.

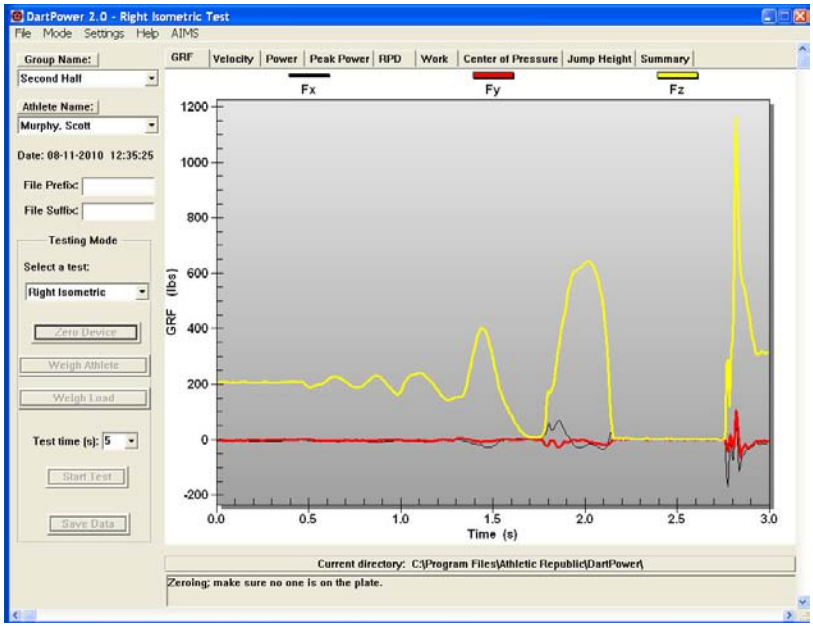
• Select proper athlete(s) for testing. This can be accomplished thru the use of an RFID bracelet linked to the athlete(s) or by manually selecting the proper athlete from the drop down menu(s) on the left side. Groups and athletes are downloaded from AIMS at login.

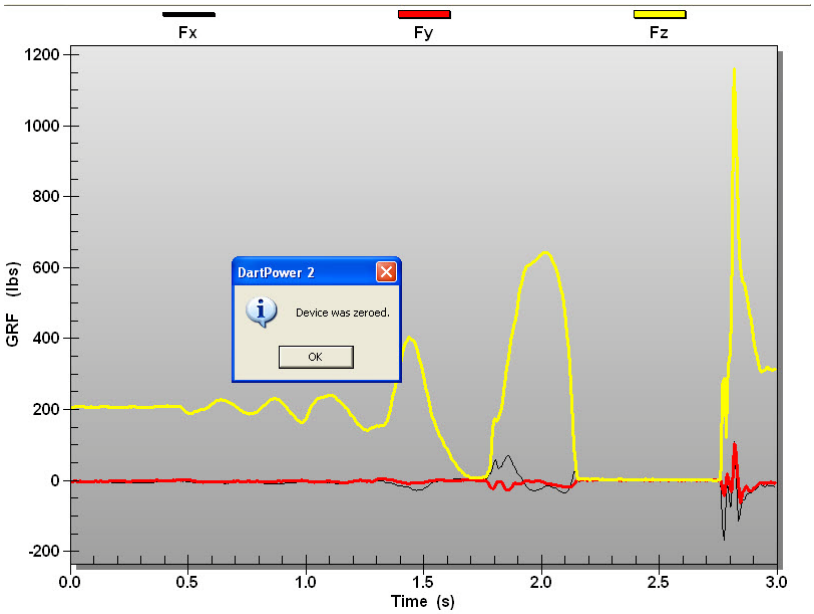


• Select a test type using the drop-down menu on the left side of the screen.

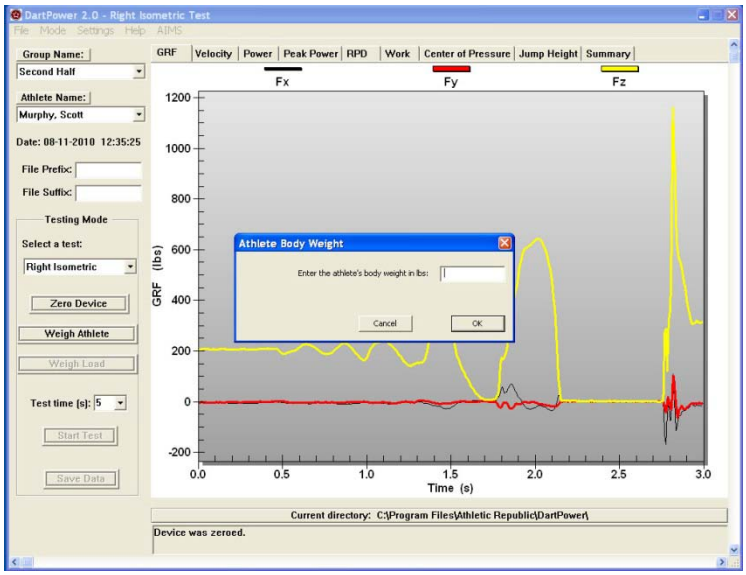


• Click “Zero Device” to zero the platform. A message will be displayed on the screen when completed. **Make sure the platform is unloaded**!



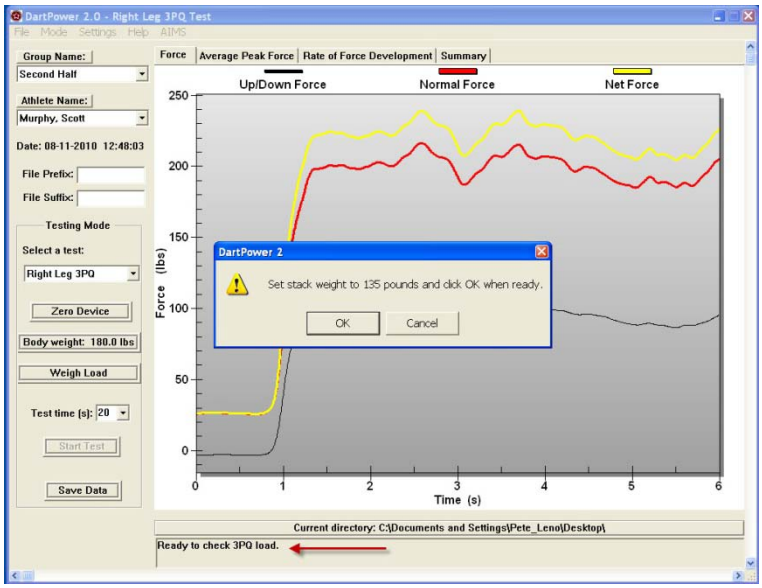


•Next enter the athlete's body weight by clicking on "Weigh Athlete" button. A box will appear on the screen for you to enter the correct body weight. Each athlete needs to be weighed only once each evaluation session.

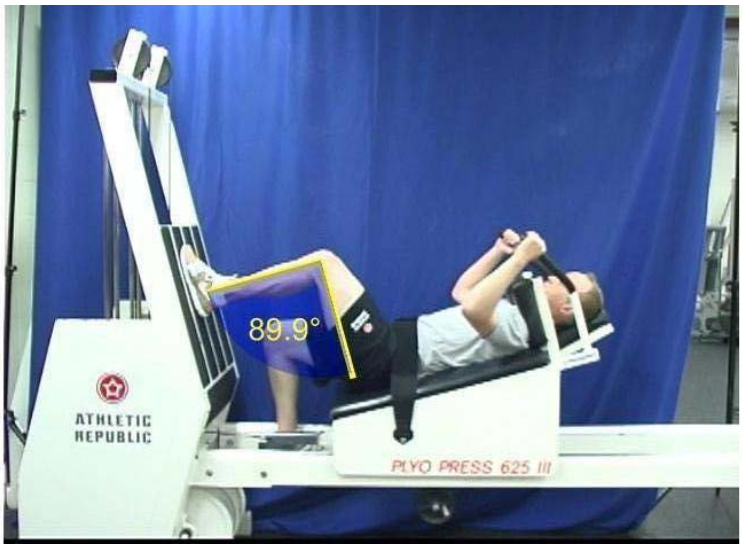


After entering a body weight, the “Weigh Load” button should be enabled. Click the “Weigh Load” button. At that point, the program will calculate the load you should put on the PlyoPress, which will appear in the load box. The load will be 1.2 x body weight for the double leg test, and 80% of body weight for single leg tests.

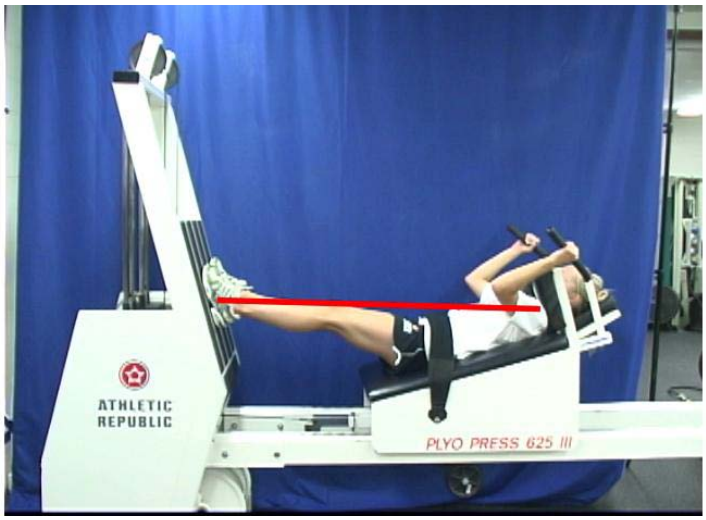
Set the PlyoPress weight stack so that the load matches the specified number that appears in the load window.



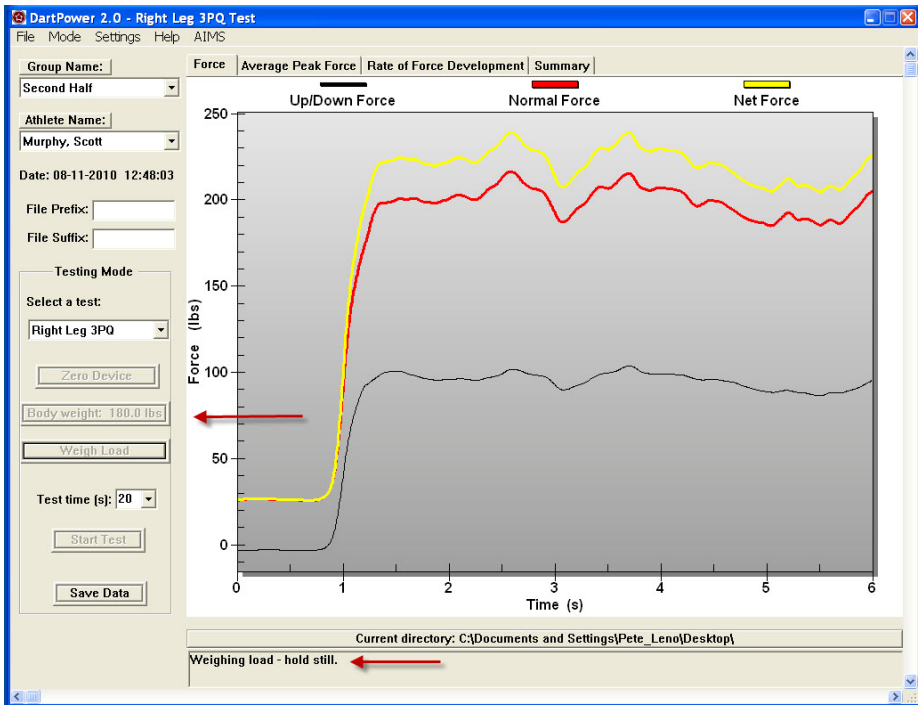
Have the athlete get into the proper position on the PlyoPress. The foot position should be so that the metatarsal heads are on the same horizontal line with the front of the shoulders, with the knees at 90 degrees.

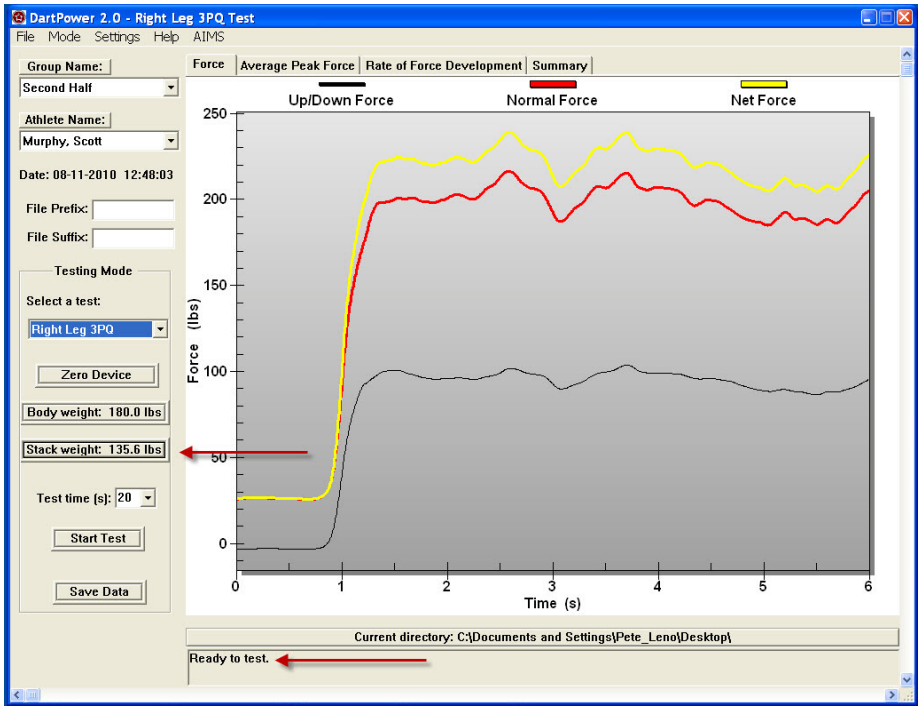


Instruct the athlete to press the load to full extension and hold the weight steady, locking their knees. When they have settled into this position, click the “OK” button in the Weigh Load window.



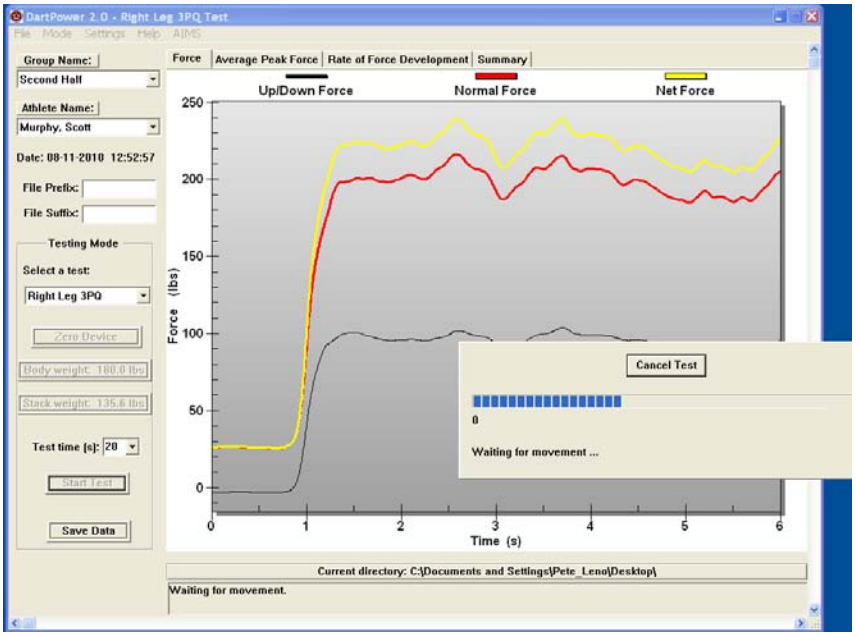
The 3PQ will measure the load to ensure the correct weight was selected and get a verification of the baseline load at the extended distance. When the sampling is completed, the athlete can let the weight down and rest. The “Weigh Load” button will now display the measured load.



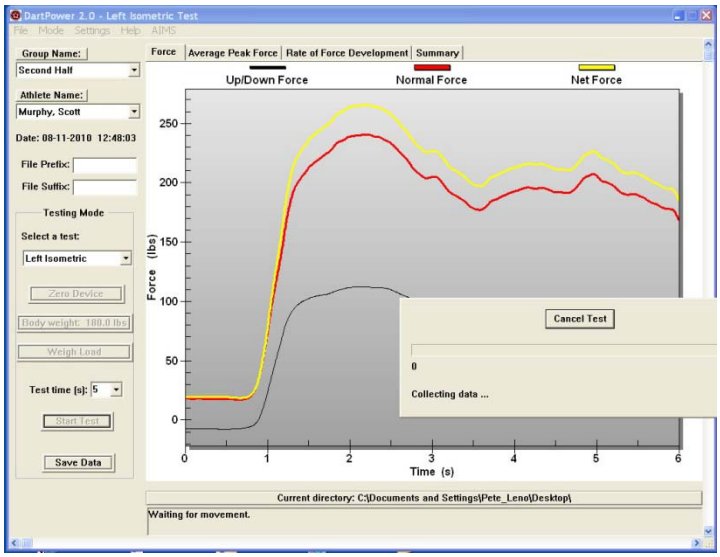


• When the athlete is ready to perform the dynamic 3PQ test, have them press the weight up to full extension Click “Start test” to begin collecting data. The test will start when the athlete begins to lower the weight.

For any power analysis, it is important that data collection be started BEFORE the subject starts to move to ensure accurate power calculations to be done. In other words, the subject should not be moving when the test is started. A progress bar window will appear and indicate the test progress through completion.



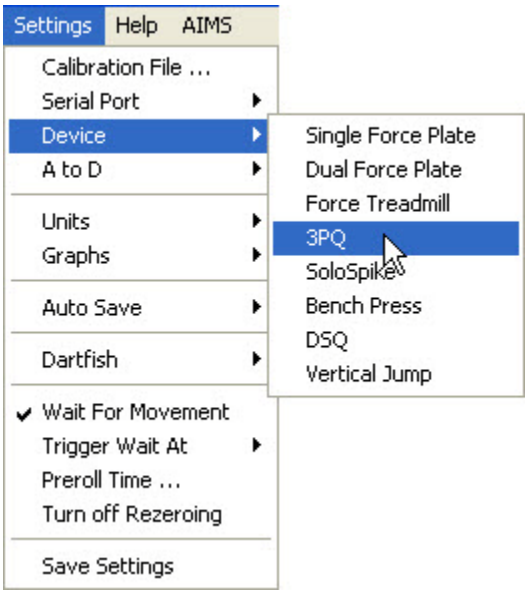
Have the athlete jump as powerfully as possible for the entire duration of the test.



3PQ Isometric Test

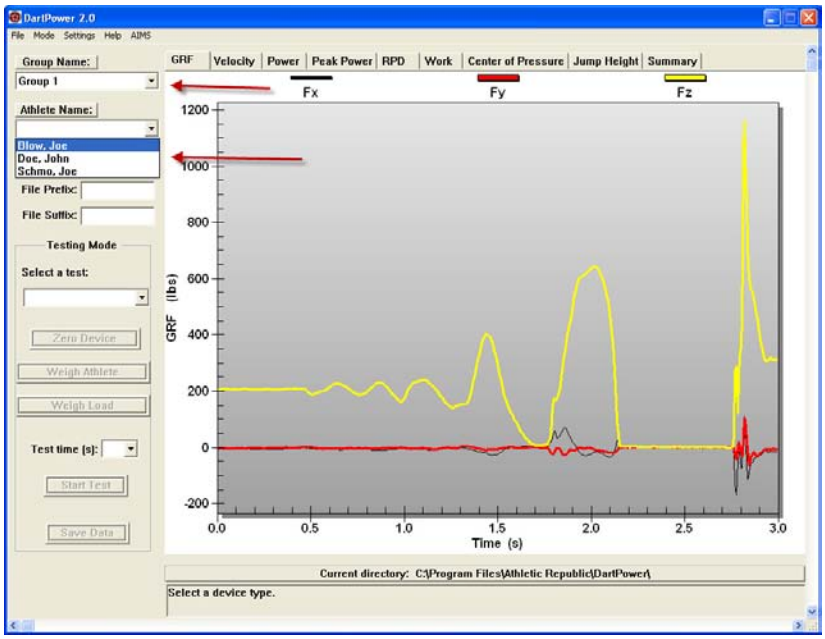
• Ensure the platform and power supply cables are connected to the PC. Also, ensure the Displacement Transducer is properly attached to the Plyo Press.
• Launch DartPower software from desktop icon.
  • Check to be certain you have the proper Calibration file and Serial Port selected.

  Go to **Settings** Menu to select device. Choose "3PQ". Once the device is selected, communication is established with the force plate.

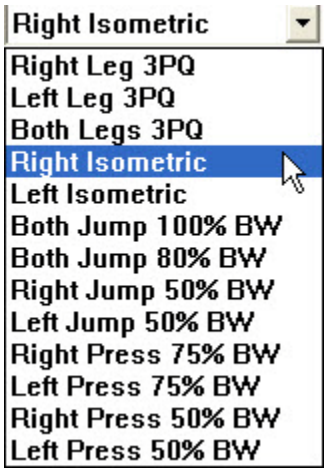


• Save Settings.

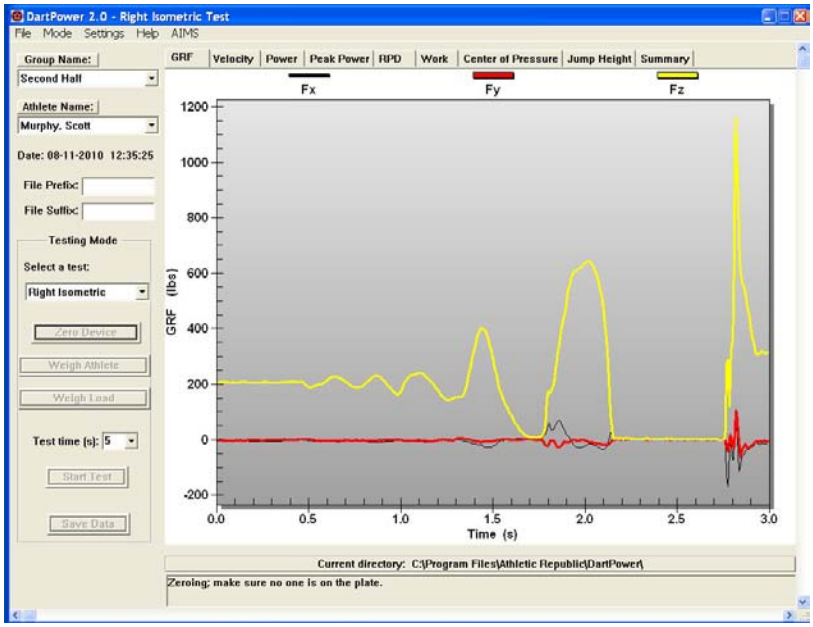
• Select proper athlete(s) for testing. This can be accomplished thru the use of an RFID bracelet linked to the athlete(s) or by manually selecting the proper athlete from the drop down menu(s) on the left side. Groups and athletes are downloaded from AIMS at login.

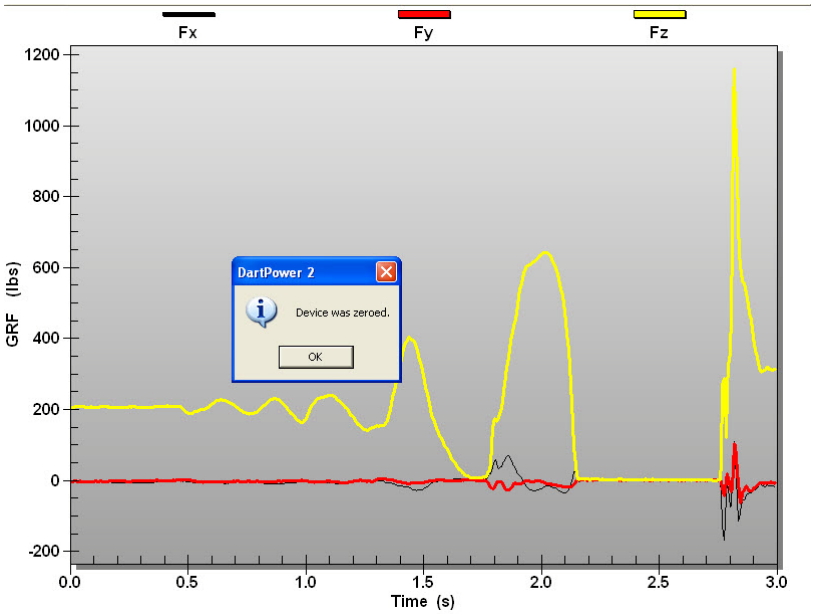


• Select a test type using the drop-down menu on the left side of the screen.

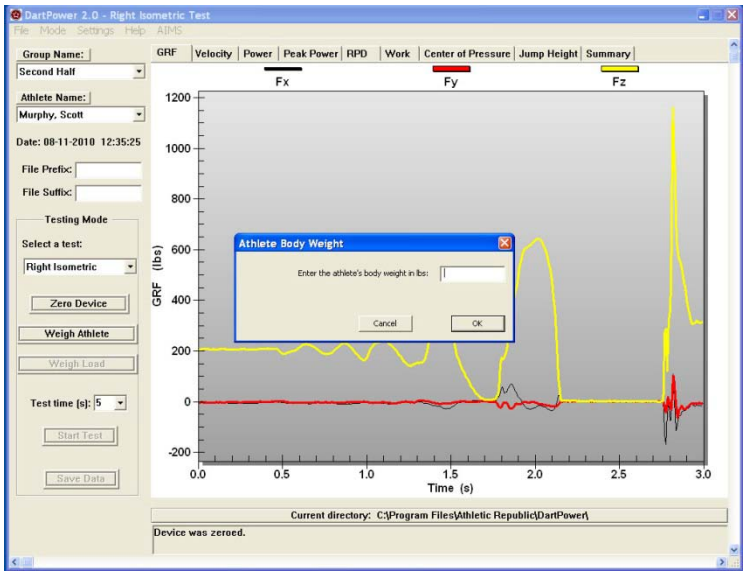


• Click “Zero Device” to zero the platform. A message will be displayed on the screen when completed. **Make sure the platform is unloaded**!



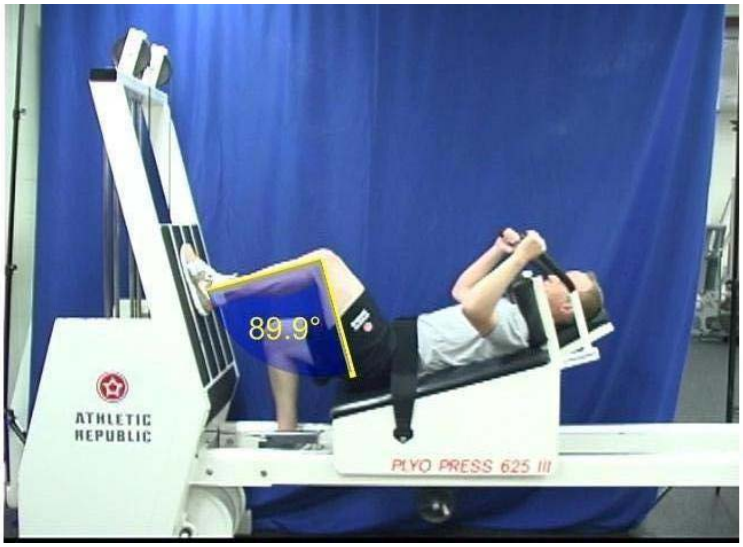


•Next enter the athlete's body weight by clicking on "Weigh Athlete" button. A box will appear on the screen for you to enter the correct body weight. Each athlete needs to be weighed only once each evaluation session.



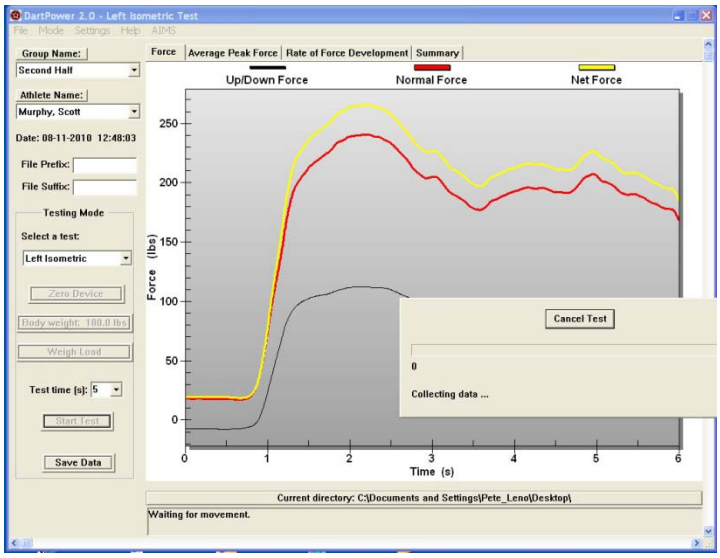
- After entering a body weight, the “Start Test” button should be enabled. Set the PlyoPress weight stack so that the load consists of the entire stack. The weight stacks cannot move during the test.

  - Have the athlete get into the proper position on the PlyoPress. The foot position should be so that the metatarsal heads are on the same horizontal line with the front of the shoulders, with the knees at 90 degrees.



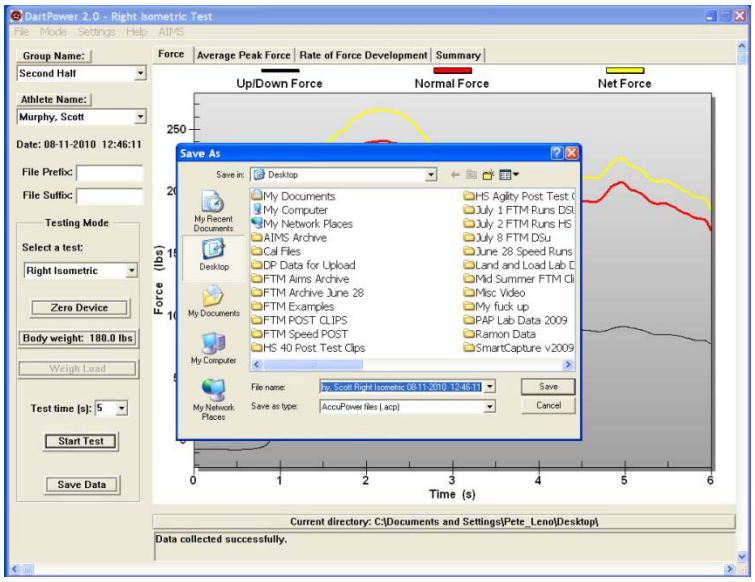
• When the athlete is ready to perform the Isometric 3PQ test, click “Start test” to begin collecting data. The athlete should be instructed to push with maximal effort against the plate for the 5 second test. The test will start when the athlete begins to press against the force plate.

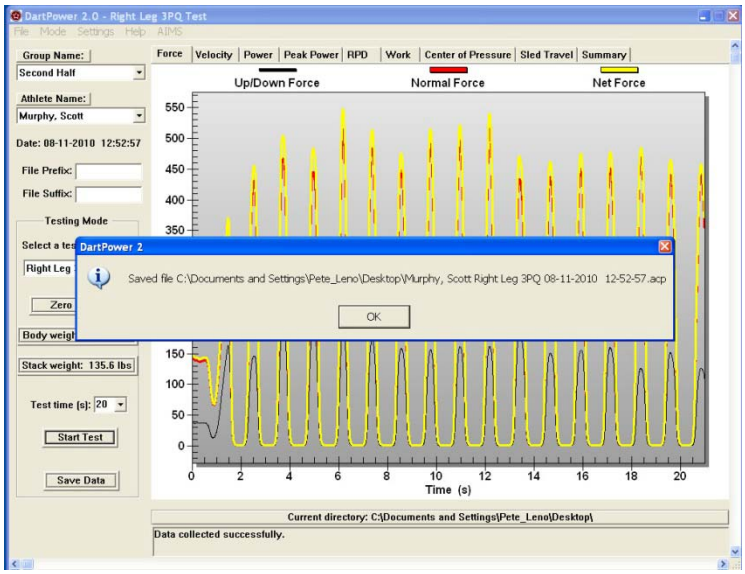
For any power analysis, it is important that data collection be started BEFORE the subject starts to move to ensure accurate power calculations to be done. In other words, the subject should not be moving when the test is started. A progress bar window will appear and indicate the test progress through completion.



Viewing and Saving the Data

Upon completion of the test, data will appear in the graph panel to the right of the window. You can check the integrity of the data by clicking on each tab to see the Ground Reaction Force (GRF), COM Velocity, Power, Peak Power, RPD, Work, COP, Jump Height Data, and Summary Table. More details on graphics functionality and interpreting data are provided in corresponding sections of this manual. If auto save is not enabled, click “Save Data” or “File/Save Test Data As” to save the time series (.acp file) and discrete data for each jump (.acp2 file). Data files can be opened and compared using “File/Open data file” and “File/Open Overlay File”.





User's Manual

Introduction

The DartPower Software is a simple, yet powerful data collection and analysis program designed to work specifically with the AccuPower and 3PQ force platforms. The user interface was created to allow quick and easy performance assessments of the ground reaction force patterns of individuals during functional, dynamic movements on the AccuPower or 3PQ. The user interface is conducive to large-scale testing in a sport-science laboratory, performance training center, or rehabilitation setting. The

measurements focus on comparing the force and power output profiles generated by athletes during any movement sequence that can be performed on the plate. Power output is calculated based on the impulse-momentum approach—which assumes that the recorded changes in force in relation to bodyweight will accelerate or decelerate the subject's center of mass accordingly.

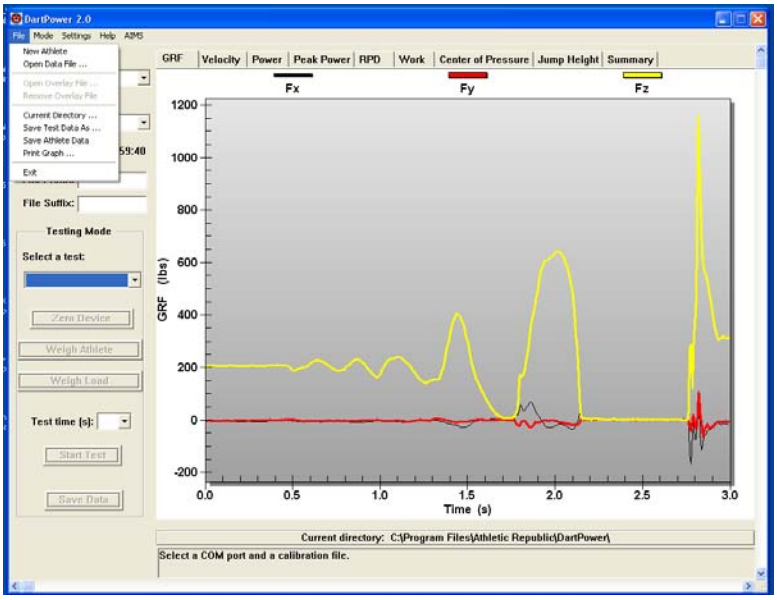
If you are reading this, you are one of the few people who actually read software manuals and will find that this document is designed to be a "quick reference" to assist you in better utilizing the software. The following pages describe the basic functionality and measures calculated by the DartPower software.

User Interface

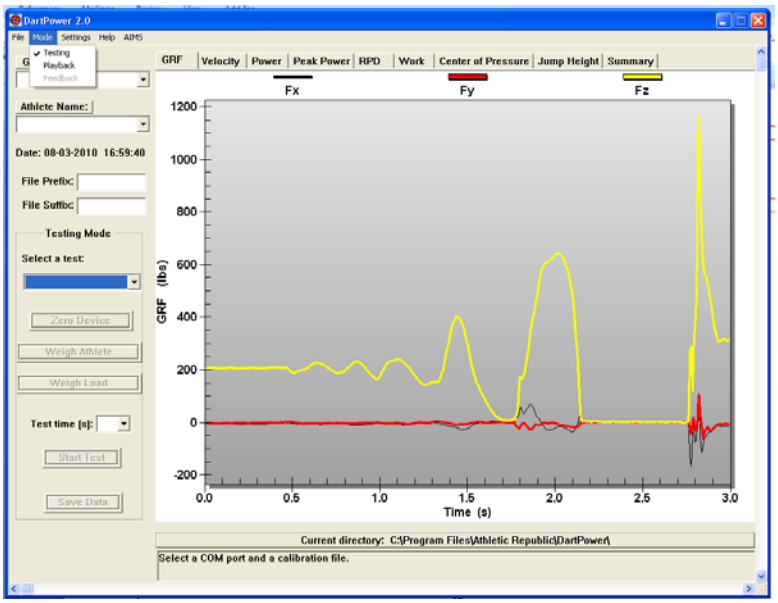
The user interface for DartPower is similar to many Windows-based programs. Key areas of the interface are indicated below:

Menu options:

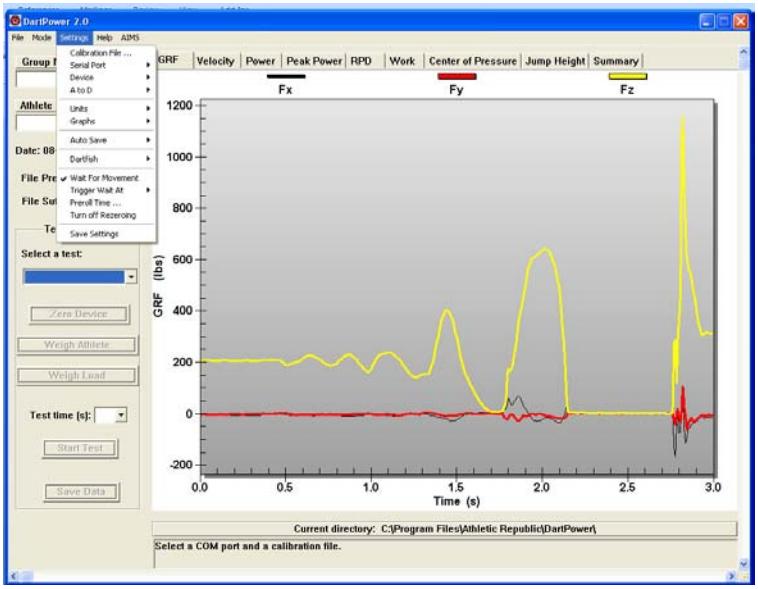
• **File:** Drop down selections related to opening, saving, and comparing data files.



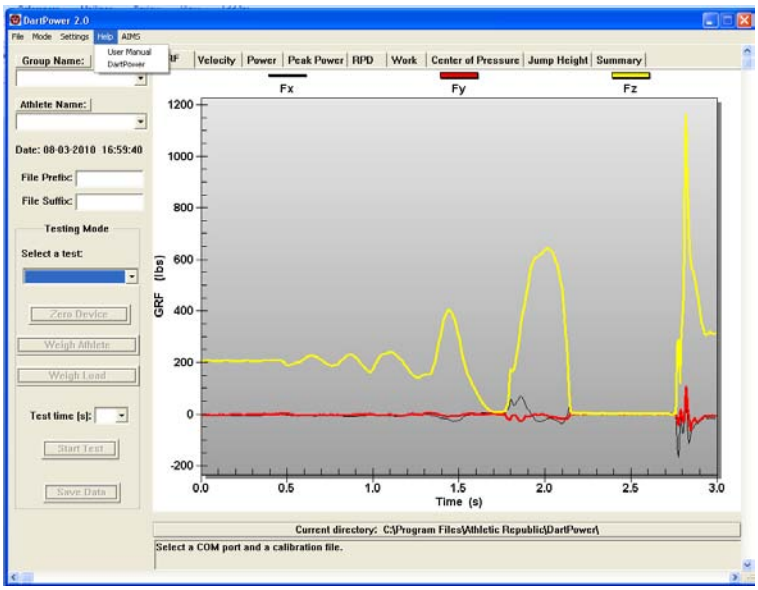
• **Mode**: Drop down selections that toggle program "modes"



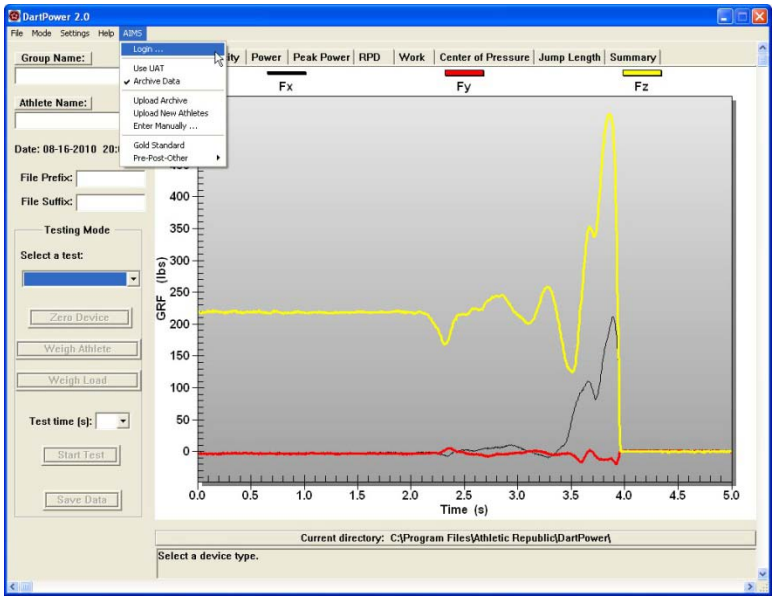
• **Settings:** Drop-down selections for selecting DartPower settings. Checked items indicate current settings.



• **Help:** Accesses current help document and program information



• **AIMS:** Drop-down selections for settings related to interaction with AIMS. Checked items indicate current settings.



Data Graphics area: Displays data associated with selected file/s. Graphic representations of the values of Ground Reaction Force (force-time), Velocity, Power, Peak Power, Rate of Power Development, Work, Center of Pressure, Jump Length, and a Summary Table are included.

File Menu Items

New Subject:

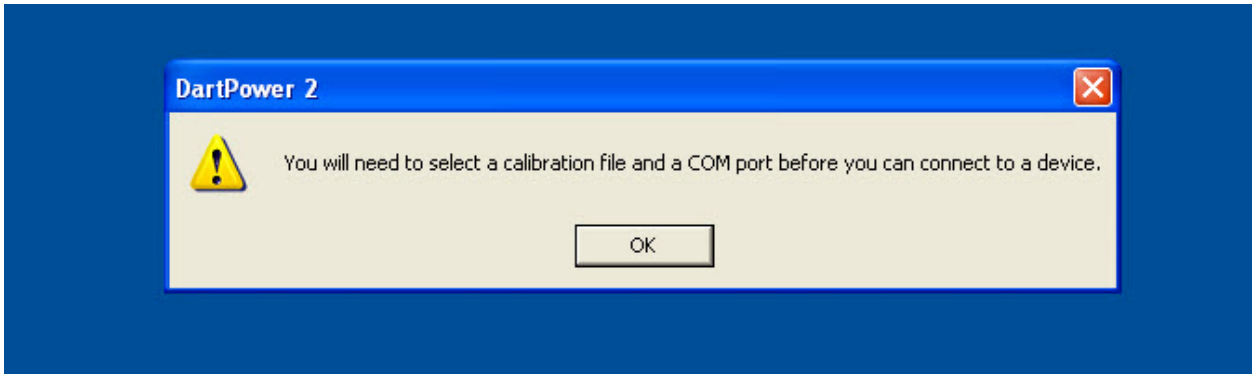
Open Data File: Allows user to open existing data files using a standard Windows Open File dialogue. Defaults to the folder where data was last saved.
Open Overlay File: Allows user to compare two data files by plotting a second selected data file in the graphics panels using a standard Windows Open File dialogue. A legend at the bottom of the graph panel designates the corresponding files.
Remove Overlay File: If an overlay file is loaded, this operation will remove it from the graph panel.
Current Directory: Allows user to choose current directory for saving data files to.
Save Test Data As: Allows user to save or re-save current data file with another name. Two files will be saved:
• .**acp file:** ASCII file containing time series data of the forces, moments, COM velocity, and power recorded during each test. Test type, subject ID, test date, and body weight are also recorded in the header of the file—making batch processing possible in common data analysis programs such as MatLab or Excel, or for upload to AIMS.
• .**acp2 file**: Contains discrete data for each "jump" as defined below. This file is useful for import into statistics software.

Settings Menu

The settings menu allows the user to configure DartPower as they wish. Most of the settings are "toggle"-type settings. Current selections are indicated by a "check" next to the menu item.

Default settings are loaded at program startup based on the information stored in the "AccuPowerSettings.ini" file. This file is created or modified using the **"Save Settings"** operation described below. Any changes made in using the menu list toggles will be maintained during the current session (i.e. until DartPoweris closed). They will only become a default setting if "Save Settings" operation is used.

Calibration File: Allows user to select the corresponding calibration file provided by AMTI (on the software installation CD). If a calibration file has been successfully associated, a message box appears up startup informing the user which calibration file has been loaded as shown below in the first screenshot. **Please use the "Digital_xxx.acl" calibration file.** If no calibration file has been associated previously (i.e. stored using the "save settings" operation described below), DartPower will inform the user that no calibration file has been loaded as seen in the screenshot below. If the calibration file has NOT loaded successfully, it is important to re-associate the calibration file again using "Settings/Calibration" procedure.

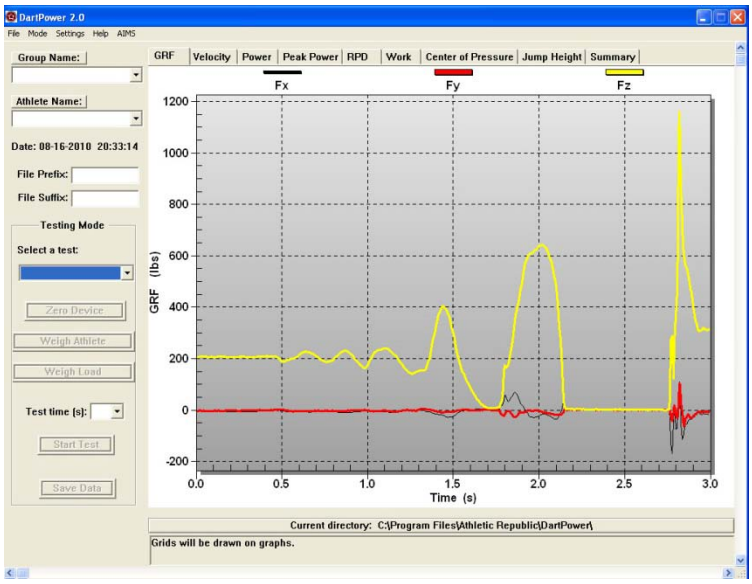


Units: Allows user to specify which units they would prefer to use during data collection or playback. SI or English units are available choices. The "scale to BW" setting normalizes any calculations to body weight recorded during the test session.

A/D: Allows specification of the sample rate of the analog to digital converter embedded in the platform. The default setting is 200 Hz or 200 samples per second. All time series data files will be stored at the data rate selected.

Serial Port: Allows user to specify a COM port number for serial communications. This is useful if other COM ports are being used to connect to other serial devices and serial communications with the force plate were not automatically established. Proper serial port can be chosen by the user with the "search" option or by manually selecting correct port with the assistance of the Device Manager. If serial communication with the plate is not successful, a message box will warn the user that it was "Unable to connect to the force plate".

Graphs: Allows user to toggle gridlines on the graphic panel.



Auto Save: Specifies the settings for saving files automatically at the end of data capture. Any combination of the following four settings can be selected:

Enable Auto Save: DartPower will automatically save data files upon completion of a test sequence if checked. This is the default setting.
Overwrite existing files: If checked, DartPower will automatically *overwrite* files of the same filename. Use caution with this setting!
Prompt for filename: If checked, DartPower will prompt the user to edit the filename before saving. The default filename is a concatenation of the Name, Test Type, Date, and Time of test administration. This is a default setting.
Auto Increment: If checked, DartPower will add a number to each filename starting at one. This is a default setting.
Dartfish: Only applies to users that intend to integrate Dartfish digital video capture withDartPower.
Save Settings: This command updates the"AccuPowerSettings.ini" file with the current configuration of the entire settings menu as determined by the user. The settings stored in "AccuPowerSettings.ini" will be the defaults upon startup of DartPower. Make sure to use this command if you want the change the current configuration of default settings.

Graphics and Animation controls

Data Tabs: Selecting a tab at the top of the graph panel will result in an update of the graph panel with the data type selected. Each data type and the method used to calculate them is described later.
Vertical Line or Cursor: A left-mouse-button click anywhere in the graph panel will produce a vertical line or "cursor" and text boxes indicating the corresponding values of the data in the graph panel. The timestamp value in seconds of where the click was made will also appear. Using the left or right arrow keys, a user can move the cursor to the right or left along the data series and the corresponding values in the text boxes will appear. Selecting a different data series will disable the cursor.

Screenshot of graph panel illustrating cursor functionality:

Zoom Controls

The following buttons are designed to work based on the position of the cursor. The graph panel will update once any of the following buttons are selected.
Clip Left: Eliminates all data to the left of the current cursor position.

Clip Right: Eliminates all data to the right of the cursor position.
Zoom Up: Clicking on this button will decrease the range of the vertical scale of the graph making the data appear larger in the vertical dimension. Each click will change the scale by 10%.
Zoom Down: Clicking on this button will increase the range of the vertical scale by 10%--opposite of the "Zoom Up" button.
Reset Button: Clicking this button will reset the graph to its original load position.
AccuPower 1.5 User Manual Page- 11 -
Right Mouse Button: Dragging the right-hand mouse button on the graph will zoom in on the outlined area. Double-clicking the right mouse button will reset the graph to normal view.

Printing Graphs

The current graph panel can be printed by selecting "Print" from the file menu. A Windows print dialogue will appear and provide basic operations for changing the margins, page orientation, and printer selection. If a color printer is selected, the data will appear in colors without the blue background to save ink. If a black and white printer is selected, the graphs will print in grey-scale. Only one graph will be printed with each print command.
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Modes of Operation

There are two basic "modes" of operation of the DartPower software:

Testing and Playback. The current mode is indicated in the "Mode" menu. Each mode is described in the following paragraphs.

Testing Mode

You must be in testing mode to collect data and it is the default upon program startup. The following operations should be performed *in the following order* to collect data.

Setting Test Parameters

Prior to data collection, there are three basic items to configure in order to ensure a smooth data collection process.

• **Set a filename using the Name and ID text boxes:** The data filename will be a concatenation of the Name + ID text boxes. If auto increment is selected, the current test number will be added (restarting at one when the program is started).
• **Select a Test Type:** DartPowerhas several types of performance analyses to select from. Based on the selection, DartPoweris "expecting" a certain type of movement to be performed on the plate in order to calculate COM velocity and power efficiently and accurately. For example, any of the "jump" test types (vertical or long jump) expect that the athlete starts and ends their movement sequence on the force platform. A description of each test type selection is as follows:
Single vertical jump: Expects the athlete to perform 1-3 jumps on the platform (single or both legs).
Single long jump: Used to assess standing long jump capabilities of an athlete (single or both leg). The estimated resultant velocity of the COM at takeoff is used to calculate the horizontal distance the COM will travel based on projectile motion. The calculations assume the COM will land at the same height as the surface of the force platform. The athlete must initiate the jump on the plate, but should not land on it.
o 30 sec vertical jump: Typically used to assess peak power, dynamic balance and "fatigue" characteristics of an athlete in repeated jumps with both legs. Depending on the athlete being tested, 30 seconds may be too long for a single leg hop test comparison.
o User-defined w/ load. This test type should be used if the athlete is using an added load during the movement (barbell, weighted vest, etc.). The user will be prompted to weigh the athlete without the load and then again with the added load to calculate the added load. As in other tests, results can be expressed relative to the athlete's body mass. AccuPower does NOT assume that a jumping motion will be performed—although the athlete may perform jumps. Typical testing situations could be Olympic lifts, jumps or other movements with a weighted vest. User-defined tests also do not require the athlete to initiate movement on the force platform.
o User-defined w/ no load: The assumptions that AccuPower makes to perform calculations are the same as the "User-defined" w/ load, except that the user is not prompted to weigh the athlete with an added load. The athlete does NOT have to start or end the movement on the platform. Typical testing situations would be drop jumps from a standard height, throwing movements, hitting (golf/baseball) movements, figure skating jumps,

etc.
Change the test duration (optional): With each test type, you have the option to change the test duration to any value 120 seconds or less.

Acquiring and Saving Data

• **Zero the platform:** Before the first test is performed, it is required that you zero the force platform. Make sure nothing is on the force platform and simply click the "Zero" button. A "beep" will sound when the button the zero process is initiated and another will sound when the process is complete. A progress bar will also appear during the sequence. Although not required with each test, a "zero" should be done at least every 10 minutes of testing or between each athlete.
• **Weigh the subject:** Before each test is performed, it is required that you weigh the athlete. ***All COM velocity and power calculations require an accurate body weight***. The athlete should stand still during the 3-second weighing sequence. Any deviations of more than 10% of the average body weight during the sequence will prompt the user to repeat the process. A "beep" will indicate the start and end of the 3-second process and a progress bar will appear.
• **Click the Start Test button:** When the platform has been zeroed and the subject weighed (or additional load recorded if user-defined with load is selected), you are ready to initiate the data collection process. Simply click the "Start Test" button to initiate data collection. A "beep" will sound when data collection is initiated and again upon completion. A progress bar will show the test progress.

Playback Mode

Playback mode in AccuPower allows a user to view and compare files with some advanced graphics features not enabled in either testing or feedback mode. There are two possible ways to enter playback mode:
• Using the "Mode" menu to toggle into Playback mode from either testing or feedback mode.
• Using the "File Open" command from the file menu automatically switches AccuPower to playback mode.

Comparing Two Data Files:
It is possible to compare two AccuPower data files using the "Open Overlay File" command from the file menu. This menu selection will result in the graph panels displaying data from the two selected files.

In order to do this, a user must load a data file into AccuPower using the "Open Data File" option from the file menu. The second data file is then loaded using the "Open Overlay File" option from the file menu. The data

panels will be updated and an appropriate legend displayed for each data type to indicate the corresponding file. A user can load another data file for comparison simply by using the “Open Overlay File” option again. The overlay file can be removed from the graph panels by using the corresponding option from the file menu (“Remove Overlay File”). With the exception of the “COP” and “Force Vector tabs”, all data panels allow file comparison via the overlay commands as described above.

Explanation of Raw and Calculated Data Panels

Force (GRF)

Three orthogonal force signals are displayed in force graph panel. Their sign convention is shown below. A force applied in the *opposite* direction of the arrows will have a negative value. Fz is the vertical or force perpendicular to the surface of the force platform. A force applied into the plate is shown as positive (i.e. placing a mass on the surface of the plate results in a positive Fz value).

:

COM Velocity

Center of Mass (COM) velocity is calculated using an impulse-momentum approach. Units are either meters/second or ft/second. Basically, Newton’s 2nd law of motion (Force = mass * acceleration) is used to calculate the acceleration of the body’s COM by dividing the force signal by the weight of the subject recorded during the “weigh” process. COM velocity is then calculated by integrating the acceleration signal with respect to time. AccuPower is able to minimize error in the integration process during repeated jump sequences due to “drift” of the baseline force signal with respect to bodyweight using a proprietary algorithm that adjusts the COM velocity value at the landing of the consecutive jumps. The “adjustment” is based on the estimation of the COM velocity at the landing of the second and consecutive jumps in a sequence. This initial landing velocity is estimated using projectile motion equations from the resultant take-off velocity of the previous jump and a time correction between take off and landing of consecutive jumps.- If the subject steps off or stops moving during the test sequence, COM velocity will “reset” to zero and then begin the integration process again to minimize error in the integration process due to “drift”.

Power

The power time series data are simply the product of the resultant force signal and the resultant COM velocity. Units are in Watts or Watts/kg body weight. Negative power values indicate a deceleration of the body’s COM or absorption of energy. Positive power values indicate an acceleration of the body’s COM or generation of energy. The power generated or absorbed by an athlete during a movement sequence has been shown to correlate well with performance in a variety of sports. Periodic performance testing using force and power variables can be especially helpful in effective training

program design. Most of the subsequent calculations available in the graph panel are based on some aspect of the power-time series data for each file.

Rate of Power Development (RPD)

This metric stands for Rate of Power Development. It is basically the average slope of the line from the negative peak power to the subsequent positive peak power during a jump or repeated jump sequence. Such a measure gives the user an indication of the athlete's ability to quickly change the direction of the center of mass during an explosive movement sequence. It would stand to reason that such a measure is important pre-requisite for success in any athletic movement. The figure below illustrates how this measure is calculated:

An illustration of how the Dartpower software calculates RPD. Each jump sequence contains negative and positive power values as negative corresponding to *deceleration* of the body's COM while positive values indicate an *acceleration* of the COM. The Neg-Pos RPD calculation results in one discrete value for each jump as shown below:

A fifteen second jump test is shown above in which the subject performed 15 jumps. RPD values are calculated for each jump that included a deceleration-acceleration of the body's COM.

Peak Power

Peak positive and negative power values for each jump are provided in a graph format identical to RPD. These values simply correspond to the negative and positive peak power values during each jump.

Jump Height / Distance

A jump height or distance is calculated for each jump sequence based on the resultant take off velocity of each jump. If a vertical jump test type is selected, the value represents the maximum vertical coordinate of the COM trajectory following take off of each jump. These calculations are based on projectile motion equations. Jump distance for the long jump test type represents the maximum horizontal distance the COM travels following take-off assuming the height of the landing surface is the same. Projectile motion equations are also used to estimate this distance from the resultant COM velocity at take off. Values are usually less than typically measured with a tape measure as the athlete takes off in an extended horizontal position.